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GREEN ENERGY FOR "SELF RELIANT INDIA": WILL INDIA ACHIEVE ZERO CO_2 EMISSION TARGET BY 2070?

Dr. Rahat Jehan

Department of Economics, Vinoba Bhave University, Hazaribagh

ABSTRACT

Energy, power, or electricity is an important infrastructure factor affecting the country's economic growth and welfare. The demand for energy in India has increased by more than 60% per capita since 2000. India is also responsible for a 10% rise in the world's energy demand since 2000. The increasing demand has made the world move forward with reliable renewable energy sources instead of non-renewable energy ones. There are mainly three triggers why the world including India is focusing on green and clean energy sources- first- because of climate change mitigations, second- energy security, and 3rd- net-zero targets. Due to the current status of the climate crisis, a sustainable economy has now become a challenge. Understanding the need for renewable energy the Govt. has announced INR 20.97 trillion revival package for the economy. While addressing the COP 26 summit the Govt. of India also has committed to ambitious targets of expanding the capacity to 175 GW of renewable energy by 2022, and 500 GW of non-fossil fuel energy by 2030 at the Net Zero target by 2070. India has ranked 4th in wind power, and 5th in solar power and renewable power installed capacity in 2021. But still, only 23% of the electricity is produced by renewable sources in India. It is therefore a matter of concern that such a landmark policy will succeed as our economy is still reliant on fossil fuel energy sources. This paper also discusses the achievements and challenges to achieving the clean and green energy targets for Aatm Nirbhar Bharat.

KEYWORDS: Climate Change, Renewable Energy, Installed Capacity, Aatm, Nirbhar Bharat, Net Zero Targets

INTRODUCTION

Renewable energies are sources of clean, inexhaustible, and increasingly competitive energy. They differ from fossil fuels principally in their diversity, abundance, and potential for use anywhere on the planet, but above all, in that they produce neither greenhouse gases – which cause climate change – nor polluting emissions. Their costs are also falling at a sustainable rate, whereas the general cost trend for fossil fuels is in the opposite direction despite their present volatility. The increasing rate of CO_2 emission has now become a major concern for not only India but all over the world. India's growth rate of CO_2 emission is the highest after China. According to a report of COP 27, India has the highest growth rate of approx. 6% CO_2 emissions.[1] India's total emissions in 2021 have been pegged at 2.7 billion tons. India's share of total global CO_2 emissions stood at 7.5 percent in 2021. And over 40% of energy-related carbon dioxide emissions are due to burning fossil fuels for electricity generation. India is the 3rd largest producer and consumer of coal in the world. To fulfill its energy needs India also imports costly fossil fuels[2]. Approx. 75% of the energy need in India is still fulfilled by coal.[3] According to a report from the Center for Monitoring Indian Economy, the country imported 171 million tons of coal in 2013–2014, 215 million tons in 2014–2015, 207 million tons in 2015–2016, 195 million tons in 2016–2017, and 213 million tons in 2017–2018.[4] Electricity generation through coal emits around 1.1Gt CO2 approximately 2.4 of global emissions and one-third of the total GHGs emission. Coal-based power plants contribute around 50% of the country's fuel-related Co2 emissions. Therefore, there is an urgent need to find alternate sources for generating electricity. Now, due to the current state of crisis, sustainable economic growth has now become a challenge. Understanding the need for sustainable economic growth our Hon'ble while addressing COP 26 summit held at Glasgow prime minister announced INR 20.97 trillion in packages to revive the economy Called "Self Reliant India". The scheme announced by the Govt. of India is to revive the 5 sectors – economy, infrastructure, system, vibrant demography, and Demand to fight covid-19 pandemic.

In November 2021, at the COP-26 Summit in Glasgow, Prime Minister Mr. Narendra Modi on the behalf of India committed to increasing India's renewable energy generation and reducing carbon emissions. The following targets have been set by India to achieve sustainable development and avoid catastrophic climate change.

- 175 GW renewable energy by 2022
- Non-fossil energy capacity to 500 GW by 2030.
- 50% of its energy requirements are from renewable energy by 2030.
- India will reduce the total projected carbon emission by one billion tons from 2021 to 2030.
- India will reduce the carbon intensity of its economy by less than 45%.
- India will achieve the "Net Zero" carbon emissions target by 2070.

REVIEW OF LITERATURE

There are several research works with respect to the need and potential growth of renewable energy sources. Kumar, A. et al.2010 in their article," renewable and sustainable energy reviews" states that To meet the energy required for such a fast-growing economy, India will require an assured supply of 3–4 times more energy than the total energy consumed today. M.A. Majid & Kumar, C.R.(2020) in their research work "Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities" also state that sustainable development is possible by the use of sustainable energy and by ensuring access to affordable, reliable, sustainable, and modern energy for citizens. Strong government support and the increasingly opportune economic situation have pushed India to be one of the top leaders in the world's most attractive renewable energy markets.

OBJECTIVES

- To highlight the need for renewable energy in India and its growth rate
- To highlight the achievements and challenges to the pathway of net zero Targets

METHODOLOGY

The present paper is based on the targets and achievements in the field of installation of the renewable energy sector in India. For this, the evaluation of the recent reports and the growth pattern of renewable energy in India have been evaluated.

RESULTS AND DISCUSSION

Renewable energy sources play a vital role in securing sustainable energy with lower emissions.[5] India has already progressed a lot in the field of the generation of renewable energy. India is the world's largest producer and the third largest consumer of electricity, with national grid-connected installed capacity reaching 374 gigawatts (GW) as of November 2020. Electricity production reached 1,252.61 billion units (BU) in FY20. India was ranked fourth in wind power, fifth in solar power and fifth in renewable power installed capacity in 2018.

The installed capacity of renewable energy sources in India in 2022

India has also almost achieved its aim of producing 175GW of energy through renewable sources. Out of which its aim was to generate 100GW from solar power, 10 GW from Bio-power, 60 GW from wind power, and 5 GW from small hydropower plants by the year 2022.

India has achieved an installed capacity of renewable energy sources including large hydropower is about 163 GW as on 31Aug, 2022. The total share of the renewables is given below:- Wind power- 41.2 GW, solar power 59.43 GW, Biomass/Co-generation- 10.2 GW, Small Hydro Power: 4.88 GW, Waste to Energy: 0.47 GW, Large Hydro: 46.85 GW, rooftop solar 7.5 GW.

RE sources	Target (in GW)	Achievements (in GW)
Solar Utilities	60	51.2
Rooftop solar	40	7.5
Bio-power	10	10.2
Wind	60	41.8
Waste to energy	---	0.47
large hydro	---	46.85
Small Hydro	5	4.88
Total	175	162.61

Source: https://www.niti.gov.in

Table 1: the installed capacity of renewable energy sources in India as on 31 Aug, 2022

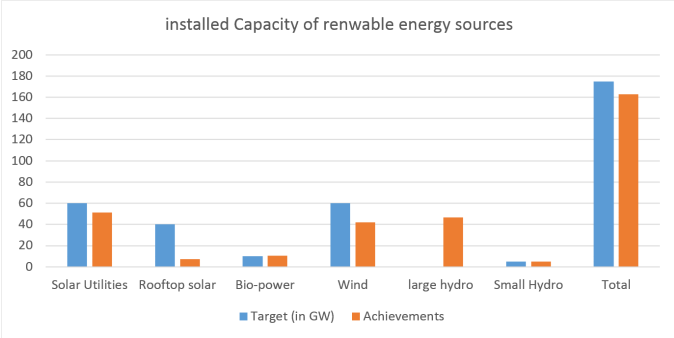


Figure 1: the installed capacity of renewable energy sources in India in 2022

Cumulative Renewable energy Sources over the last 6 years (in GW)

The table below shows the cumulative energy capacity installation over the last 6 years. The table shows that the solar power installed capacity has increased tremendously from 9 GW in 2017 to 51.6 in 2022. Bio-Power has also achieved more than its target of 10.7 GW in 2022. But there is not any significant increase in wind power installed capacity.

Year	solar	Bio-power	wind	Small hydro
Jan-17	9	8	28.7	4.3
Oct-17	14.8	8.3	32.7	4.4
Oct-18	24	8.9	34.6	4.5
Oct-19	31.7	9.9	37.1	4.6
Oct-20	36.3	10.3	38.3	4.7
Oct-21	47.7	10.6	40	4.8
0ct 2022	51.6	10.7	41.8	4.9

Source: Central electricity authority

Table 2: Cumulative Renewable energy capacity over last 6 years (in GW)

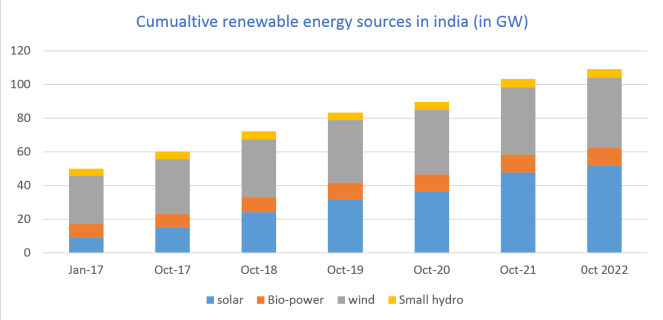


Figure 2 Cumulative Renewable energy capacity over last 6 years (in GW)

The contribution of Renewable Energy sources in total energy Demand in India

According to the International Renewable Energy Agency (IRENA), a quarter of India's energy demand can be met with renewable energy. The country could potentially increase its share of renewable power generation to over one-third by 2030.[6]

Year	Installed capacity of renewable energy sources (GW)	Expected Generation (Billion Unit)					Total energy requirement (Billion Unit)	The Contribution of renewable energy source in (%)
		Solar	Wind	Bio-mass	Small hydro-power	Total		
2021-22	175	162	122	38	15	327	1611	20.3
2026-27	275	243	188	64	21	516	2132	24.2

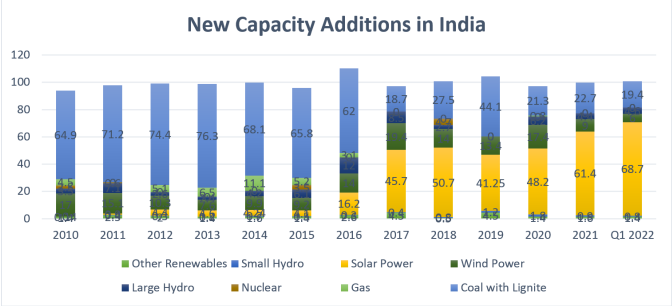
Report of ARENA

Table 3: The contribution of Renewable Energy sources in total energy Demand in India

Table 3 presents the estimated contribution of renewable energy sources to the total energy demand. Mop along with CEA in its draft national electricity plan for 2016 anticipated that with 175 GW of installed capacity of renewable power by 2022, the expected electricity generation would be 327 billion units (BUs), which would contribute to 1611 BU energy requirements. This indicates that 20.3% of the energy requirements would be fulfilled by renewable energy by 2022 and 24.2% by 2027.[7]

The Share of new capacity additions of all energy sectors in India (2010-2022)

The table shows the growth rate of additional installed capacity in renewable sectors has tremendously increased. The share of installed solar power in India has increased with a growth of 68.7% in 2022. The share of wind power has increased by 6%, and large hydro has increased additional capacity of 4.6% in 2022.[8]



Source: - CEA, MNRE, Mercom India Solar Project Tracker

Note:-MNRE's revised cumulative bio-power data not included in this figure

Figure 3: The figure below shows the new power additions in all sectors in between (2010- 2022) solar accounts for 68.7% of new capacity addition during 2022

Share of fossil and non-fossil fuel energy source in total energy generation:

The table shows that as on 31.12.2022 the total share of coal in energy generation is 49.7% and its installed capacity is about 203,775 MW and the total installed capacity of fossil fuel in 2022 was 2,35,809 MW with a total share of 57.5%. Whereas, the total installed capacity of non-fossil fuel energy sources including large hydro and nuclear energy sources is about 174,530 with only 42.5 % total share of power generation.

Installed GENERATION CAPACITY(FUELWISE) AS ON 31.12.2022		
Fossil Fuel		
Coal	203,775	49.7%
Lignite	6,620	1.6%
Gas	24,824	6.1%
Diesel	589	0.1%
Total Fossil Fuel	2,35,809	57.5 %
Non-Fossil Fuel		
RES (Incl. Hydro)	167,750	40.7%
Hydro	46,850	11.4 %
Wind, Solar & Other RE	120,900	29.5 %
Wind	41,930	10.2 %
Solar	63,302	15.1 %
BM Power/Cogen	10,210	2.5 %
Waste to Energy	522	0.1 %
Small Hydro Power	4,936	1.2 %
Nuclear	6,780	1.7%
Total Non-Fossil Fuel	174,530	42.5%
Total Installed Capacity (Fossil Fuel & Non-Fossil Fuel)	410,339	100%

Source: https://powermin.gov.in/en/content/power-sector-glance-all-india

Table 4: installed capacity generation of installed RE & NON-RE sources and their share in total

The total installed capacity of power generation including fossil and non-fossil fuel is about 410,339 MW as on 31.12.2022. These table and data show that as we have almost achieved the 175 GW power till 2022 the country is on track to achieve 500 GW in 2030. But still, some renewable sources have not improved yet and for the fulfillment of energy demand, we are still dependent on coal or on-fossil fuel as it contributes 57.5% of the total electricity generation.

Initiatives and achievements:

To achieve the renewable energy target of 500 GW by 2030 Govt. has launched various schemes and initiatives:-

1. **Solar Park scheme:** To facilitate large scale grid-connected solar power projects, a scheme for "Development of Solar Parks and Ultra Mega Solar Power Projects" is under implementation with a target capacity of 40 GW capacity by March 2024. As on 31-10-2022, 56 Solar Parks have been sanctioned with a cumulative capacity of 39.28 GW in 14 states. Solar power projects of an aggregate capacity of over 10 GW have already been commissioned in 17 parks and the remaining parks are at various stages of implementation. Solar projects of capacity 832 MW have been commissioned in various Solar Parks during period January to October, 2022.

2. **PM-KUSUM Scheme:** Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahaabhiyan (PM-KUSUM): To provide energy and water security, de-dieselise the farm sector and also generate additional income for farmers by producing solar power, Government launched PM-KUSUM Scheme for farmers.

The Scheme consists of three components:

Component A: Installation of 10,000 MW of Decentralized Grid Connected Solar Power Plants each of capacity up to 2 MW

Component B: Setting up of 20 lakh standalone Solar Powered Agriculture Pumps

Component C: Solarisation of 15 Lakh existing Grid-connected Agriculture Pumps

The Scheme aims to add 30.8 GW of solar capacity with the central financial support of over Rs. 34,000 Crore

Achievements of PM-KUSUM scheme:

1. under component A- cumulatively installation of about 73.45 MW capacity of small solar power plants
2. 1.52 lakh standalone solar pumps under component-B of which 79,418 pups have been installed during 2022.
3. Solarisaiton of 48.2 lakh grid-connected pumps under the two variants of component C

Solar Rooftop Scheme:

The progress of cumulative installed capacity up to 2022 was 7.2 GW with progress of 1.33 GW during year 2022. Total 35000 cr. investment for the scheme was done up to 2022. Total 2.838 GW capacity was installed with CFA (centaral Financial Assistance) out of which 1.3 GW capacity installation was doen under pahase 1 and 1.48 GW capacity installation was done under phase 2. Around 5.5 GW capacity was sanctioned for CFA in 2022.

Off-Grid Solar:

Atal Jyoti Yojana: under Atal Jyoti Yojana total of 1.46 lakh solar street lights were installed, 9.71 lakh solar study lamps were distributed and 2.5 MW solar parks have been set up according to State Nodal Agencies(SNAs).

Green Energy corridor: under Green Energy Corridor projects the govt. govt. has initiated inter-state GEC with target capacity As on 31.10.2022, 8651 ckm (circuit kilometer) of intra-state transmission lines have been constructed and 19558 MVA intra-state substations have been charged. During the calendar year 2022 a total of 183 ckm of transmission lines have been commissioned and 4930 MW capacity of substations have been charged.

Production Linked Incentive (PLI) Scheme: The production Linked Incentive Scheme "National Programme on High Efficiency Solar PV Modules" was introduced with an outlay of Rs. 4500 crores to support and promote manufacturing of high-efficiency solar PV modules, including the upstage vertical components like cells, wafers, ingots and polysilicon in India and thus reduce the import dependence in Solar PhotoVoltaic (PV) sector.

Central Public Sector Undertaking (CPSU) Scheme: scheme for setting up 12 GW Grid- Connected Solar PV Power Projects by Central Public Sector Undertakings with domestic cells and modules is under implementation. Viability Gap funding support is provided under this scheme.

Challenges in Achieving the Target:

- Mobilization of the Necessary Finance:
  - Gearing up the banking sector for arranging finances for larger deployment goals, exploring low-interest rate, and long-term international funding, and developing a suitable mechanism for risk mitigation or sharing by addressing both technical and financial bottlenecks are major challenges.

- Land Acquisition:
  - Identification of land with Renewable Energy potential, its conversion (if needed), clearance from the land ceiling Act, decision on land lease rent, clearance from revenue department, and other such clearances take time.
  - State governments have to play a major role in acquisition of land for RE projects.

- Creating Ecosystem:
  - Creating an innovation and manufacturing eco-system in the country.

CONCLUSION

The renewable sector suffers notable obstacles. Some of them are inherent in every renewable technology; others are the outcome of a skewed regulative structure and marketplace. The absence of comprehensive policies and regulation frameworks prevents the adoption of renewable technologies. The renewable energy market requires explicit policies and legal procedures to enhance the attention of investors. There is a delay in the authorization of private-sector projects because of a lack of clear policies. The country should take measures to attract private investors. Inadequate technology and the absence of infrastructure required to establish renewable technologies should be overcome by R&D. The government should allow more funds to support research and innovation activities in this sector. There is insufficiently competent personnel to train, demonstrate, maintain, and operate renewable energy structures and therefore, the institutions should be proactive in preparing the workforce. Imported equipment is costly compared to that locally manufactured; therefore, the generation of renewable energy becomes expensive and even unaffordable. Hence, to decrease the cost of renewable products, the country should become involved in the manufacturing of renewable products. Another significant infrastructural obstacle to the development of renewable energy technologies is unreliable connectivity to the grid. As a consequence, many investors lose their faith in renewable energy technologies and are not ready to invest in them for fear of failing. India should work on transmission and evacuation plans.

Inadequate servicing and maintenance of facilities and low reliability in technology decrease customer trust in some renewable energy technologies and hence prevent their selection. Adequate skills to repair/service the spare parts/ equipment are required to avoid equipment failures that halt the supply of energy. Awareness of renewable energy among communities should be fostered, and a significant focus on their socio-cultural practices should be considered. Governments should support investments in the expansion of renewable energy to speed up the commercialization of such technologies. The Indian government should declare a well-established fiscal assistance plan, such as the provision of credit, deduction on loans, and tariffs. The government should improve regulations making obligations under power purchase agreements (PPAs) statutorily binding to guarantee that all power DISCOMs have PPAs to cover a hundred percent of their RPO obligation. To accomplish a reliable system, it is strongly suggested that renewables must be used in a hybrid configuration of two or more resources along with conventional source and storage devices. Regulatory authorities should formulate the necessary standards and regulations for hybrid systems. Making investments economically possible with effective policies and tax incentives will result in social benefits above and beyond the economic advantages.

Future Research Directions

Further research should be done to evaluate the impact of non-fossil fuel in the reduction of co2 emissions and to find the drawbacks why the govt. could not meet its target of 175 GW. And if the pattern of under-achieving the target will continue in the future what will the effect of zero co2 emission in 2070? Will India be able to achieve zero emission targets?

FOOTERNOTES

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